

# **NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

## **PRESS KIT**

**November 2000**

## **EO-1/SAC-C**



[General Release](#)  
[Media Services Information](#)  
[EO-1 Quick Facts](#)  
[SAC-C Quick Facts](#)  
[EO-1 Mission](#)  
[SAC-C Mission](#)  
[EO-1 Program/Project Management](#)  
[SAC-C Program/Project Management](#)  
[EO-1 Science Team Website](#)  
[Mission Timeline](#)

Bruce Buckingham                      Launch Operations                      (321) 867-2468  
Kennedy Space Center

## UNIQUE SATELLITE DUO ON TARGET FOR NOV. 18 LAUNCH

NASA is set to embark on a mission that could change the way we look at satellite technology, as well as change the way we look at the Earth. Launch for this important satellite duo is scheduled Nov. 18 from Vandenberg Air Force Base, CA.

The Earth Observing 1 (EO-1) satellite and SAC-C, an international cooperative mission between NASA and the Argentine Commission on Space Activities (CONAE) are scheduled to soar into orbit at 1:24 p.m. EST.

In 1996, NASA started the New Millennium Program (NMP), designed to identify, develop and flight validate key instrument and spacecraft technologies that can enable new or more cost-effective approaches to conducting science missions in the 21st century. The first of three New Millennium Program Earth-orbiting missions is EO-1, an advanced land-imaging mission that will demonstrate new instruments and spacecraft systems.

EO-1's primary focus is to develop and test a set of advanced technology land imaging instruments. However, many other key instruments and technologies that will have wide ranging applications for future satellite development are also part of the mission.

Future NASA spacecraft are expected to be smaller, lighter and less expensive than current versions, and the EO-1 mission will provide the on-orbit demonstration and validation of several subsystem technologies to enable this transition.

EO-1 will be inserted into an orbit flying in formation with the Landsat 7 satellite taking a series of the same images. Comparison of these "paired scene" images will be used to evaluate EO-1's land imaging instruments.

Swales Aerospace, Beltsville, MD built the EO-1 spacecraft bus under a NASA contract. Litton Amecom, College Park, Md. is the key avionics subcontractor. The three primary instruments on the EO-1 observatory are the Advanced Land Imager, the Hyperion and the Linear Imaging Spectrometer Array (LEISA) Atmospheric Corrector (AC).

Joining EO-1 aboard the Delta rocket is the SAC-C spacecraft, an international mission to study the structure and dynamics of the Earth's atmosphere, ionosphere and geomagnetic field. SAC-C also will seek to measure the space radiation in the environment and its influence on advanced electronic components and determine the migration route of the Franca whale. Another objective of the payload is to verify autonomous methods of attitude and orbit determination.

The SAC-C mission is a collaboration between the United States, Argentina, Brazil, Denmark, France and Italy.

SAC-C has an instrument payload of 11 different instruments. Eight of those instruments are dedicated to better understanding the Earth's environment and ecology. SAC-C will carry three GPS instruments to test new technology in spacecraft development and environmental monitoring.

The Commission on Space Activities (CONAE) is responsible for development of the spacecraft and several instruments. The Brazilian Space Agency provided the testing facilities for SAC-C. The Italian Space Agency has partnered with CONAE to supply both solar panels and two GPS receivers. The Danish Space Research Institute provided the Magnetic Mapping Payload which carries a NASA Supplied Helium Magnetometer, and the French Space Agency is contributing an experiment to test the response of electronic circuitry to space radiation.

The launch vehicle and some science instruments aboard SAC-C are provided by NASA. NASA's Goddard Space Flight Center, Greenbelt, MD, is responsible for overall project management, on behalf of NASA's Earth Sciences Enterprise, Washington, DC. The Earth Science Enterprise is a long-term research program dedicated to understanding how human-induced and natural changes affect our global environment.

To learn more about EO-1 on the Internet, visit:

**<http://www.gsfc.nasa.gov/gsfc/earth/eo1/eo.html>**

To learn more about SAC-C on the Internet, visit:

**<http://www.conae.gov.ar/sac-c>**

-End of General Release-

## **Media Services Information**

### **NASA Television Transmission**

NASA Television is broadcast on the satellite GE-2, transponder 9C, C band, 85 degrees west longitude, frequency 3880.0 MHz, vertical polarization, audio monaural at 6.8 MHz. On launch day, television coverage will begin at 9 a.m. PST and continue through spacecraft separation. The schedule for television transmissions for EO-1 will be available on the NASA Television homepage at <http://www.nasa.gov/ntv/> .

### **Audio**

Audio only will be available on the V circuits that may be reached by dialing 407/1220, 1240, 1260, 7135, 4003, 4920.

### **Briefings**

The prelaunch news conference will be held on Friday, Nov. 17 at 11 a.m. PST in the main conference room of the NASA Vandenberg Resident Office, Building 840, Vandenberg Air Force Base, CA.

### **News Center/Status Reports**

The EO-1/SAC C News Center at the NASA Vandenberg Resident Office will open November 16 (L-2) and may be reached at (805) 605-3051. Recorded status reports will be available beginning L-2 at (805) 734-2693, or at (301) 286-NEWS.

### **Launch Media Credentials**

U.S. News media desiring accreditation for the launch of EO-1/SAC-C should fax their request on news organization letterhead to:

NASA Vandenberg Resident Office  
Vandenberg Air Force Base, CA  
Attention: Bruce Buckingham  
FAX: 805/605-3380

Foreign news media desiring accreditation should fax their request to:

30th Space Wing Public Affairs Office  
Vandenberg Air Force Base, CA  
Attention: Staff Sgt. Rebecca Bonilla  
FAX: 805/606-8303

For further information on launch accreditation call 321/867-2468. Beginning Nov. 16 call the NASA EO-1/SAC-C News Center at Vandenberg Air Force Base 805/605-3051.

## **Internet Information**

More information on the EO-1/SAC-C mission, including an electronic copy of this press kit, press releases, fact sheets, status reports and images, can be found at:

<http://www.gsfc.nasa.gov/gsfcearth/eo1/eo.html>

<http://www.conae.gov.ar/sac-c/>

## **EO-1 Quick Facts**

Spacecraft Dimensions: width = 67.94 inches, height = 68.6 inches

Weight: 1,260 pounds (573 kilograms)

Science Instruments: Advanced Land Imager, Hyperion Imaging Spectrometer and the Atmospheric Corrector

Power: Three solar arrays will provide 600 watts of load power

Orbit: 438 miles (705 kilometers)

Mission Lifetime: One year

Launch Site: SLC 2 Western Test Range, Vandenberg Air Force Base, Calif.

Expendable Launch Vehicle: Delta 7320

Launch Date and Time: November 18, 2000 at 10:24 a.m. PST (22 second window)

Spacecraft Separation: Launch + 60 minutes

First Acquisition of EO-1 Signal: Six minutes after launch

Cost: \$193 million, this includes spacecraft development, launch vehicle, one year of operations as well as planned science validation activities.

Spacecraft Builder/Integrator: Swales Aerospace, Beltsville, Md. under Goddard contract

Subcontractors: Litton Amecom, College Park, Md. for key avionics.

Launch Vehicle/Operations: NASA's Kennedy Space Center

### **SAC-C Quick Facts**

Spacecraft Dimensions: 6.8 x 6.1 x 5.4 feet (2.1 x 1.9 x 1.7 meters)

Weight: 1,045 pounds (475 kilograms)

Science Instruments: The Scalar Helium Magnetometer (SHM), Magnetic Mapping Payload (MMP), Multispectral Medium Resolution Scanner (MMRS), High Resolution Technological Camera (HRTC), Influence of Space Radiation on Advanced Components (ICARE), Italian Star Tracker (IST), Whale Tracker Experiment, Italian Navigation Experiment (INES), Data Collection System, Digital Transponder for Radio Amateur Communications, and High Sensitivity Camera

Power: Dual solar arrays providing 450 Watts

Mission Lifetime: Four years

Orbit: 438 miles (705 kilometers)

Expendable Launch Vehicle: Delta 7320

Launch Site: SLC 2 Western Test Range, VAFB, Calif.

Launch Date and Time: November 18, 2000 at 10:24 a.m. PST (22 second window)

Spacecraft Separation: Launch + 91 minutes

Degree Inclination: 98.2

First Acquisition of Signal: Four minutes after separation

Cost: \$45 million U.S. dollars, not including launch

Spacecraft Provider: CONAE

Launch Vehicle/Operations: Kennedy Space Center, Fla.

Mission Management: Goddard Space Flight Center, Greenbelt, Md.

### **EO-1 Mission**

In 1996, NASA started a New Millenium Program (NMP), designed to identify, develop, and flight-validate key instrument and spacecraft technologies that can enable new or more cost-effective approaches to conducting science missions in the 21st century. The first of these New Millenium Program Earth-orbiting missions is Earth Observing-1 (EO-1), an advanced land-imaging mission that will demonstrate new instruments and spacecraft systems. EO-1 will validate technologies contributing to the significant reduction in cost of follow-on Landsat missions.

## **Instruments**

The three primary instruments on the EO-1 observatory are the Advanced Land Imager, the Hyperion and the Linear Imaging Spectrometer Array (LEISA) Atmospheric Corrector (AC).

### **ALI**

The Advanced Land Imager (ALI) employs novel wide-angle optics and a highly integrated multispectral and panchromatic spectrometer. MIT Lincoln Laboratory, Lexington, Mass. developed the ALI under project management by NASA's Goddard Space Flight Center with NMP instrument team members: Raytheon/Santa Barbara Remote Sensing (SBRS) for the focal plane system and Sensor Systems Group, Inc. (SSG) Wilmington, Mass. for the optical system.

### **Hyperion**

The Hyperion instrument provides a new class of Earth observation data for improved Earth surface characterization. The Hyperion capabilities provide resolution of surface properties into hundreds of spectral bands versus the ten multispectral bands flown on traditional Landsat imaging missions. Through this large number of spectral bands, complex land eco-systems shall be imaged and accurately classified. TRW, Redondo Beach, Calif, developed the Hyperion instrument under project management by Goddard.

### **Linear Etalon Imaging Spectral Array Atmospheric Corrector**

Earth imagery is degraded by atmospheric absorption and scattering. The Linear Etalon Imaging Spectral Array (LEISA Atmospheric Corrector (AC) will provide the first space-based test of an Atmospheric Corrector (AC) for increasing the accuracy of surface reflectance estimates. The AC provides the capabilities by a compact and simple bolt-on design for future Earth Science, land-imaging missions. Goddard's Applied Engineering and Technology Directorate (AETD) developed the AC.

## **Technologies**

### **X-Band Phased Array Antenna (XPAA)**

New Millennium Program's Earth Observing-1 (EO-1) mission will provide for the on-orbit demonstration of a high data rate, low mass X-Band Phased Array Antenna (XPAA) for down-linking imaged data from the EO-1 solid state recorder. The XPAA offers significant benefits over current mechanically pointed parabolic antennas, including the elimination of deployable structures, moving parts, and the torque disturbances that moving antennas impart to the spacecraft..

Future generations of Earth Science missions will generate terrabytes of data daily which must be returned to Earth. The XPAA provides a low cost, low mass, highly reliable means of transmitting hundreds of megabits per second to low cost ground terminals. The XPAA also has the inherent advantage of providing a body-fixed design which can allow simultaneous capture and transmission of data, avoiding perturbations to instrument measurements. The antenna was developed for GSFC by Boeing Phantom Works located in Seattle, Wash.

### **Enhanced Formation Flying (EFF)**

Enhanced formation flying (EFF) technology for onboard constellation and formation control will enable a large number of spacecraft to be managed with a minimum of ground support. The result will be a group of spacecraft with the ability to detect errors and cooperatively agree on the appropriate maneuver to maintain their desired positions and orientations. The EFF technology is applicable to any mission class, be it low-Earth or Deep Space, that desires to fly multiple satellites autonomously while gaining the added benefit of enabling science and reducing mission operations costs.

The EFF technology features flight software that is capable of autonomously planning, executing, and calibrating routine spacecraft maneuvers to maintain satellites in their respective constellations and formations.

Enhanced Formation Flying (EFF) technology enables many small, inexpensive spacecraft to fly in formation and gather concurrent science data in a "virtual platform". This "virtual platform" concept lowers total mission risk, increases science data collection and adds considerable flexibility to future Earth and space science missions.

### **Pulse Plasma Thruster**

The New Millennium Program's Earth Observing-1 mission (EO-1) will provide for the first on-orbit demonstration of a low mass, low cost,

dependable electromagnetic Pulse Plasma Thruster (PPT) propulsion unit for precision attitude control.

The PPT will be used to maintain fine pitch attitude control pointing requirements for EO-1 while meeting stringent electromagnetic and contamination constraints for the mission. A series of fine pitch pointing maneuvers will be conducted with the PPT after the baseline EO-1 mission has completed its primary land scene comparison with LANDSAT-7.

The PPT is applicable to Earth and space science missions requiring precision pointing and control. For example, the Origins Program will require precision alignment and coordination of multiple spacecraft. The PPT is a perfect candidate for these types of missions, and avoids liquid propellant sloshing which could effect instrument measurement.

Use of the PPT is particularly valuable in small spacecraft by offering a low mass and lower cost alternative to attitude control systems requiring reaction wheels and momentum unloading components. Also, the PPT may be an excellent low cost and low mass alternative for conventional delta-V propulsion systems. All of these benefits will help reduce the cost and weight of new Earth and space science missions, and will enable greater science instrumentation to be performed on any given mission.

### **Lightweight Flexible Solar Array**

The Light Weight Flexible Solar Array (LFSA) is a light weight photovoltaic solar array system. Full flight validation of the Light Weight Flexible Solar Array (LFSA) will enable the production of simpler and lower weight solar arrays. This will enable increased science measurement instrumentation to be integrated on a mission (increased payload mass fraction) enabling greater scientific return for each mission.

### **Carbon-Carbon Radiator**

Earth imagery is degraded by atmospheric absorption and scattering. The New Millennium Program's Earth Observing-1 Mission (EO-1) will provide the first space-based test of an Atmospheric Corrector (AC) for increasing the accuracy of surface reflectance estimates.

Use of Carbon-Carbon Radiators (CCR) may simplify thermal radiator design in some applications (e.g., No need for actively cooled radiators) and support increased science payload mass fraction for future missions.

### **Wideband Advanced Recorder Processor (WARP)**

The Wideband Advanced Recorder Processor (WARP) is a high rate solid state recorder on EO-1. It will be used to capture high rate range data from the Advanced Land Imager (ALI), Atmospheric Corrector (AC), and the Hyperion instruments. The input data rate to the WARP is four to five times greater than any NASA mission flying today.

The WARP incorporates a number of high density electronic board advanced packaging techniques and will provide the highest rate solid state recorder NASA has ever flown. Its basic architecture and underlying technologies will be required for future earth imaging missions which need to collect, store and process high rate land imaging data.

EO-1's high-rate imaging (almost 1 gigabit per second when all three instruments are on), required engineers to design and build a specific subsystem to handle the data rate and still maintain flight constraints of compact size and low power usage. Although not officially part of the NMP/EO-1 validation list, the Wideband Advanced Recorded Processor (WARP) is a solid-state recorder with capability to record data from all three instruments simultaneously and store up to 48 Gbits (2-3 scenes) of data before it is transmitted to the ground. WARP's compact design, advanced solid-state memory devices (3 dimensional RAM stacks) and packaging techniques enables EO-1 to collect and downlink all recorded data.

### **SAC-C Mission**

The SAC-C spacecraft is an international mission to study the structure and dynamics of the Earth's atmosphere, ionosphere and geomagnetic field. SAC C's scientific mission is to:

- Provide multispectral images of the Earth in order to monitor the condition and dynamics of the terrestrial and marine biosphere and environment
- Develop and utilize new GPS based techniques to globally measure atmospheric phenomena for the study of weather, seasonal, inter-annual and long term climate change
- Enhance the understanding of the Earth's magnetic field and related Sun-Earth interactions
- Measure high energy radiation environment, trapped particle intensities and energy distribution and correlate them with the degradation of advanced electronic components

## **NASA Related Science Instruments/Components**

The SAC C payload comprises 11 different instruments. However, NASA is responsible for only two instruments/components of the SAC-C complement. The two NASA provided instruments, both provided by JPL, are:

### **GOLPE**

The GPS Occultation and Passive Reflection Experiment (GOLPE) instrument. It consists of a TurboRogue III GPS and four high gain antennas, each facing in different spacecraft orbital directions. The GPS will study the Earth's gravity field by producing post-processed decimeter-level SAC-C orbit measurements. GOLPE will demonstrate and utilize GPS remote sensing to study weather and seasonal to long term climate change. GOLPE also will measure refractivity or bending of GPS signals hidden by Earth's atmosphere and ionosphere. GOLPE is an advanced GPS receiver capable of automatically acquiring selected GPS transmissions that are refracted by the Earth's atmosphere and reflected from the Earth's surface.

### **SHM Electronics**

The Scalar Helium Magnetometer (SHM) will be part of the Danish Magnetic Mapping Payload (MMP). The SHM will complement other MMP instruments and will be mounted at the tip of the Danish extendable boom. The SHM electronics box will be mounted on the spacecraft's lower (propulsion) platform.

## **Non-NASA Instruments**

### **MMP**

The MMP is designed to better understand the Earth's geomagnetic field and related Sun-Earth interactions. The MMP will provide continuous field measurements for a minimum of 12 months with an accuracy of one part in 50000. The MMP will be shipped from Denmark to Argentina as a complete unit including U.S. supplied hardware.

### **MMRS**

Multispectral Medium Resolution Scanner (MMRS), provided by the Argentines will study the condition and dynamics of the terrestrial and marine biosphere and environment. The MMRS will be operational over Argentina during SAC-C's lifetime.

### **HRTC**

High Resolution Technological Camera (HRTC) will improve part of the MMRS scenes. The HRTC will be operational over Argentina during the lifetime of SAC-C.

### **ICARE**

Influence of Space Radiation on Advanced Components (ICARE) experiment will measure high energy radiation environment, trapped particle intensities and energy distribution and correlate them with advanced electronic components degradation. ICARE will be able to conduct regular environment characterization campaigns for ten days every six months and exceptional ones during solar events. ICARE will study the effects on components and their variations along the same time frame.

### **IST**

Italian Star Tracker (IST) will test a fully autonomous system and orbit determination using a star tracker.

### **Whale Tracker Experiment**

Whale Tracker Experiment will track the migratory route of the Franca whale. The experiment will be operational when the spacecraft is over the South Atlantic Ocean.

### **INES**

Italian Navigation Experiment (INES) and its components will be the primary navigation sensor by the SAC-C attitude and orbit control subsystem and a secondary attitude determination sensor.

### **Data Collection System**

Data Collection System will enable SAC-C to collect environmental data from low cost ground platforms.

### **Digital Transponder for Radio Amateur Communications**

Digital Transponder for Radio Amateur Communications will allow radio amateur communications.

### **HCS**

High Sensitivity Camera (HCS) is a highly sensitive intermediate resolution camera. The HCS will be useful in forest fire and electrical storm detection.

### **Partners**

- Argentina will supply the MMRS, Whale Tracker Experiment, HCS and HRTC.
- NASA/JPL will contribute the GOLPE and SHM.
- Italy will furnish part of the solar panels and two technological experiments for orbit and attitude determination, IST and INES.
- Denmark will provide the Magnetic Mapping Payload.
- France will supply the ICARE experiment.
- Brazil will provide its testing facilities for system level testing.

### **EO-1 Program/Project Management**

The New Millennium Program is managed by NASA's Jet Propulsion Laboratory in Pasadena, California, for NASA's Office of Space Science and Office of Earth Science in Washington, D. C. NASA's Goddard Space Flight Center has project management and implementation responsibility for technology flight validation of EO-1.

#### NASA Headquarters, Washington, DC

Dr. Ghassem Asrar, Associate Administrator of the Office of Earth Science

#### Goddard Space Flight Center, Greenbelt, Md.

Bryant Cramer, NMP Program Manager  
Dale Schulz, EO-1 Project Manager  
Stephen Ungar, EO-1 Project Scientist

### **SAC C Program/Project Management**

#### CONAE, Argentina

Carlos Alonso, Project Manager  
Dr. Raul Colomb, SAC-C Project Scientist

#### NASA Headquarters, Washington, DC

Dr. John LaBrecque, SAC-C Program Scientist  
Adriana Ocampo, Program Executive

#### Goddard Space Flight Center, Greenbelt, Md.

Gustave Comeyne, Jr., Project Manager

#### Jet Propulsion Laboratory, Pasadena, Calif.

Dr. Barbara Wilson, Project Scientist

### **EO-1 Science Teams**

For further information about the science teams visit:

<http://eo1.gsfc.nasa.gov/Science/index.html>

**Mission Timeline**  
(MINUTES.SECONDS)

Liftoff 0.00  
Solid Motor Burnout (3 solid rockets) 1.04  
Solid Motor Separation (3 solid rockets ) 1.50  
Main Engine Cutoff 4.24  
Vernier Engine Cutoff 4.27  
Stage 1-2 Separation 4.29  
Stage 2 Ignition 4.38  
Jettison 10 ft. Composite Fairing 5.57  
First Cutoff - Stage 2 (SECO1) 11.16  
Stage 2 Restart 55.58  
Second Cutoff Stage 2 (SECO2) 56.16  
Separate EO-1 Spacecraft 60.00  
Separate Portion of Dual Payload Attachment Fitting 73.30  
Restart Stage 2 - 84.85  
Third Cutoff - Stage 2 (SECO3) - 85.15  
Separate SAC-C - 92.14

First contact for EO-1 is with TDRSS at L+6min, first ground station contact is with Norway (Svalbard) Ground Station at L+1hr, 17min

First contact for SAC-C is Poker Flat, Alaska at L+93 min